Bulletin of the *Transilvania* University of Braşov
Series IV: Philology and Cultural Studies • Vol. 4 (53) No.1 – 2011

# THE CVX THEORY OF SYLLABLE A SINGLE-SLOT ANALYSIS OF THE INITIAL CONSONANT CLUSTERS IN ENGLISH AND IN SLOVAK

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***Abstract:*** *The paper presents the results of the research verifying the proposed universal nature of the CVX theory of syllable. The character of the word-initial clusters in English and in Slovak has been evaluated in terms of three basic concepts of the so-called morphological approach to syllable structure as introduced by Duanmu (2009). The data indicates that while in English all onset clusters form a complex sound or can be explained by morphology, in Slovak the number of possible word-initial clusters is much higher, their structure is more heterogeneous and not all of them can be accounted for by morphology.*

***Keywords:*** *CVX theory, consonant clusters, complex sound, feature specification.*

## Introduction

The CVX theory of syllable structure (Duanmu 2009) claims that the maximal syllable size in all languages is CVX (CVC or CVV) and any extra consonants at word edges are either accounted for by morphology or can be treated as complex sounds (ibid.).

This the so-called morphological approach to syllable structure is based on the assumption that "*there is a correlation between the morphology of a language and the maximal syllable size*" (ibid., 52). Duanmu's assumption about the universal syllable structure is based on the evaluation of the data from Standard Chinese, Shanghai Chinese and Jiarong that belong to the Sino-Tibetan language family, and English and German belonging to the West-Germanic language family. As the author adds, the last two "*are chosen for their large consonant clusters*" (Duanmu, 2009, 71).

Morphology and phonotactic possibilities and constrains of genetically related languages are usually at least partly related. At this point the question arises if the CVX model of syllable is applicable

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also on the other typologically different languages, e.g. the Slovak language which belongs to the West-Slavonic languages that are all highly inflectional and allow relatively long sequences of consonants.

So as to answer this question and to verify the proposed universal nature of the CVX syllable theory, I have decided to undertake a research whose objective is to test this theory on Slovak and at the same time to provide a comparative analysis of the syllable structure and phenomena included in both languages, English and Slovak. The first step of my research, aimed at the comparison of consonant clusters in English and in Slovak, has shown that the number of possible word-initial and word-final clusters in Slovak is much higher than in English, their structure is more heterogeneous and it seems that only a few of them can be accounted for by morphology (cf. Gregová 2010).

In the second step of the research I have looked in detail at Slovak consonant clusters in terms of the articulatory features specification and the notion of a complex sound. Since the overall number of all possible initial, medial and final consonant clusters in Slovak is relatively high, this paper will deal with the initial clusters only[1].

## The CVX theory

Duanmu's idea that the maximal syllable size is CVX (CVC or CVV) is based on the following three morphological factors or concepts:

(1) **The affix rule**: "*Affix or affix like sounds can be pronounced, whether they can fit into a syllable or not*" (Duanmu, 2009, 50). For example, the final [s] in [æks] *ax* which is not the part of a syllable whose structure is VC. This final [s] is called a 'perceived suffix' (Duanmu, 2010, 8).

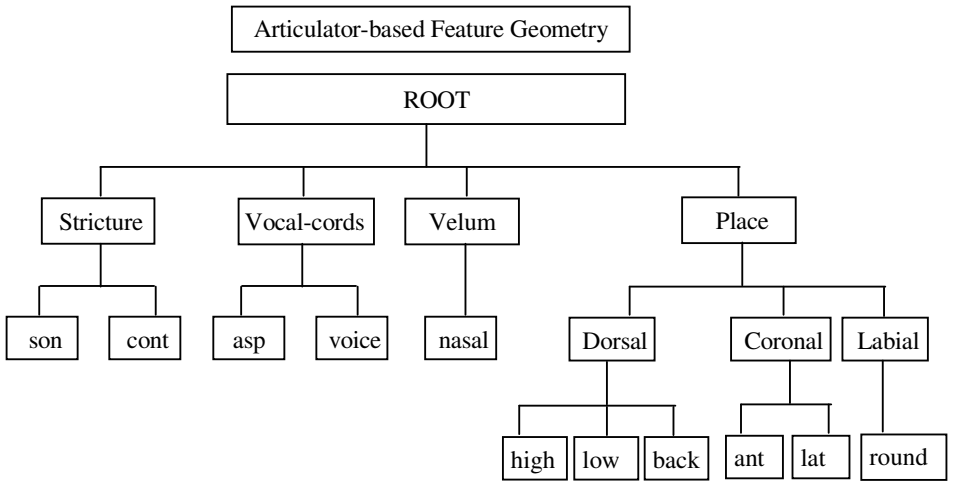
(2) **Potential Vowel Rule:** extra consonants at word edges are predictable from morphology: in languages having suffixes starting in a vowel, an extra consonant is allowed in a word-final position. This consonant can function as the onset of the suffix vowel. Analogically, in languages that have prefixes ending in a vowel, an extra consonant can be in a word-initial position in order to form a coda of the prefix with a vowel at its end (Duanmu, 2009, 70, 150). For example, the final [p] in the word *help* is an extra C when the word is in isolation (supported by anti-allomorphy; see below), but this [p] functions as the onset of the following V in the word *helping* (Duanmu, 2010, 10).

(3) **Anti-allomorphy**: "*Keep a morpheme in the same shape regardless of the environment*" (Duanmu, 2009, 47). This rule supports the syllabification of *help* as VCV + extrasyllabic consonant [hel]p (ibid., 47).

The question of how many underlying sounds can be in each of the three CVX slots is answered by the concept of a **complex sound**. The extreme case is represented by six underlying sounds which merge into three complex sounds: e. g. in the word prints [prɪnts] the CVX structure is [$p^r$ ĩ $t^s$]. [$p^r$] is formed from [p] and [r]; the nasalized [ĩ ] is formed from [ɪ] and [n], and the affricate sound [$t^s$] is formed from [t] and [s] (ibid., 70).

The notion of a complex sound has its roots in the articulator-based feature theory that distinguishes features and articulators. Articulators as the movable parts in the vocal tract participate in speech production, and the gestures made by these articulators constitute features (Marlo, 79).

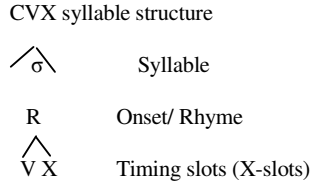
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(ibid., 80)

The most important criterion for the delimitation of a complex sound is the **No Contour Principle** which says that "*an articulator cannot make the same feature twice within one sound* " (Duanmu, 2009, 174). Thus a single sound cannot be characterised simultaneously by both [+nasal] and [-nasal], because conflicting gestures cannot overlap, they must be made in sequence and require more than one timing slot (Duanmu, 2010, 16). For example, [b] is characterised by Labial [-nasal], [m] is Labial [+nasal], therefore [bm] cannot form a complex sound. Duanmu further claims that "*if the articulatory gestures of two sounds can overlap, then they can form a complex sound*" (ibid., 5). For example, the gesture of [p] is (Labial) and that of [l] is (Coronal), they are independent and can overlap. Therefore [pl] forms a complex sound and fits in a single slot (ibid.). Since overlapping gestures are made simultaneously, a complex sound takes just one timing slot (Duanmu 2010).

All in all, there is only a single-consonant onset slot in this approach to the syllable structure (cf. Marlo 2004, Duanmu 2010):




**Single-slot analysis of the initial consonant clusters in English**

As already mentioned Duanmu tested his proposal of a syllable theory on several languages and English was included because of its well-known large consonant clusters (cf. e.g. Roach 2002, Giegerich 1992). All English word-initial, word-medial and word-final consonant clusters were thoroughly analysed in terms of the main concepts of the CVX theory. Since this paper deals with the initial clusters only, I will now briefly summarise a single-slot analysis of the English word-initial consonant clusters carried out by Duanmu (Duanmu 2009).

The word, i.e. the syllable in English can begin with a vowel, with one, two or three consonants. No word in English begins with more than three consonants (Roach, 71), thus the maximum number of segments in the word-initial consonant cluster is three.

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At the beginning of English words (syllables), there are **55 two-consonant clusters**. In many cases the first element is /s/ and the second consonant is approximant /l, r, w, j/ (cf. Gregová 2010; Roach, 73; Duanmu, 2009, 160).

***Initial CC clusters in English***

*starting with oral plosive*: pr, pl, pj, pw, pf, ps, pʃ, br, bl, bj, tr, tw, tj, dr, dj, dw, kr, kl, kw, kj, km, kn, kv, gr, gl, gw (26)
*starting with nasal plosive*: nj, mj, mw (3)
*starting with fricative*: fl, fr, fj, vj, vw, θr, θw, θj, st, sp, sk, sl, sw, sn, sm, sf, sj, sr, sv, zl, ʃr, ʃm, ʃn, ʃp, ʃw, hj (26)
*starting with approximant:* -
*starting with affricate*: -

The number of **the initial three-consonant clusters** in English is quite limited, there are 9 of them, all starting with /s/.

***Initial CC clusters in English***

*starting with fricative /s/:* spl, spr, spj, str, stj, skl, skr, skw, skj.

In terms of the articulator-based feature geometry 33 word-initial CC clusters (pr, pl, pj, ps, pʃ, br, bl, bj, tw, dw, kr, kl, kw, kn, kv, gr, gl, gw, mj, fl, fr, fj, vj, θw, sp, sk, sw, sf, sv, ʃm, ʃp, ʃw, hj) involve different articulators and 28 of them can be represented as complex sounds (cf. Duanmu, 2010, 174 – 175).

For example:
[p] Labial [+stop], [l] Coronal [+lateral]
[pl] – complex sound

[g] Dorsal, [r] Coronal
[gr] – complex sound

Clusters 'kn' and 'ʃm' cannot form a complex sound because of the different specification [-nasal] [+nasal]. Clusters 'sp', 'sk' and 'sf' are bad in the complex sound analysis too, because they have conflicting gestures (for details cf. Duanmu 2009, 2010).

In the group of the remaining word-initial CC clusters, there are 12 [pw, pf, tr, tj, dr, dj, kj, nj, mw, vw, θj, sj] that have the same articulator, but they can form a complex sound since their articulators do not have conflicting features. 10 clusters [θr, st, sl, sm, sn, sr, zl, ʃr, ʃn, km] are not complex sounds. The first consonant in these clusters is not the part of a syllable, it does not belong to the syllable onset. These unsyllabified consonants are simply accounted for by morphology – Potential V Rule (ibid.).

As to the word-initial CCC clusters, in Duanmu's view the initial /s/ can be excluded and all onset clusters either form a complex sound (they are produced with different articulator, cf. Duanmu, 2009, 43–44) or they are predictable by morphology as real or potential affixes (for details cf. Duanmu 2009).

By implication, the analysis of the data from the English language supports "*the CVX theory, in which there is only one onset slot*" (ibid., 179).

## Single-slot analysis of the initial consonant clusters in Slovak

The comparison of possible consonant clusters in English and in Slovak has shown that a Slovak word can begin with two, three or four consonants. The maximal size of Slovak onset is CCCC (cf. Gregová 2010).

In Duanmu's theory initial syllables are only those that are "… *the first after a word boundary, whether there is a prefix or not. For example, in* sprinkle, *[sprɪŋ] is initial. In* re-sprinkle, *both [ri] and [sprɪŋ] are initial"* (Duanmu, 2010, 160 – 161). Thus all traditionally delimited initial consonant clusters in Slovak were re-analysed in terms of this approach. Some consonant clusters were excluded from the further analyses, because they are not monomorphemic, e.g. originally delimited two-consonant cluster '*zr*' in the word *zrub*

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(*chalet*) is decomposable into prefix 'z' and stem '*rub*'. On the other hand some two-consonant clusters were included as the result of the decomposition of three or four-consonant cluster, e.g. originally three-consonant cluster '*vzb*' in the word *vzbura (revolt*), morphematic structure *vz-bur-a*, contains prefix 'vz' and thus only '*vz*' can be treated as the initial cluster. Or four-consonant cluster '*fspl*' in the word *vzplanúť (flare up)*, sound form [*fsplanúť*] is not monomorphemic. The morphematic structure of the word is *fs-plan-ú-ť*, therefore both *'fs'* an *'pl'* are initial.

All in all, in the initial position of Slovak words (syllables), there can be **117 monomorphemic two-consonant clusters**, **23 monomorphemic three-consonant clusters** and **two monomorphemic four-consonant clusters**.

***Initial CC clusters in Slovak***

*starting with oral plosive:* ps, pš, px, pn, pň, pl, bď, bz, bl, bľ, br, tk, tx, tv, tm, tl, tľ, tr, dv, dm, dn, dň, dl, dr, kt, kv, km, kn, kň, kr, kl, kľ, gn, gň, gl, gľ, gr (37)

*starting with nasal plosive*: mn, mň, ml, mľ, mr (5)

*starting with fricative*: sp, st, sť, sk, sx, sv, sm, sn, sň, sl, sľ, zb, zv, zn, zň, zl, zr, šp, št, šť, šk, šm, šn, šl, šľ, šr, žv, žm, žň, žľ, žr, hn, hň, hl, hľ, hr, hm, hv, xc, xv, xm, xl, xľ, xr, ft, fť, fč, fs, fš, fl, fľ, fr, vd, vz, vn, vň, vl, vr, lk, lž (60)

*starting with affricate*: cv, cť, cm, cn, cň, cl, cľ, čp, čv, čm, čl, čľ, čr (15)

***Initial CCC clusters in Slovak***

*starting with oral plosive*: tkv (1)

*starting with nasal plosive*: mdl (2)

*starting with fricative*: vzd, vzl, str, skl, skľ, skv, smr, stl, zdr, zvl, zbr, zhl, zdr, škr, štv, škv, štr, špľ, špr, hml, hmľ, ľst (22)

*starting with affricate*: -

***Initial CCCC clusters in Slovak***

*starting with oral plosive*: pstr, pštr (2)

*starting with nasal plosive*: -

*starting with fricative*: -

*starting with affricate*: -

All 142 monomorphemic initial consonant clusters were evaluated in terms of a complex sound analysis. In the group of the initial CC clusters starting with oral plosive, 21 can be represented as a complex sound. In most of them, there are segments produced by different articulator, i.e. there are no conflicting gestures.

For example:
[p] Labial, [s] Coronal, [**ps**] – complex sound
[k] Dorsal, [l] Coronal, [**kl**] – complex sound
[d] Coronal, [v] Labial, [**dv**] – complex sound

16 of the initial CC clusters (pn, pň, tm, tl, tľ, tr, dm, dn, dň, dl, dr, km, kn, kň, gn, gň) cannot represent a complex sound. Sounds in these clusters involve the same articulator and have conflicting features:

[**pn**], [**pň**] – not complex sounds; opposite value carried by the articulator Velum
[p] – [-nasal], [n,ň] – [+nasal]

**[tl], [tľ]** – not complex sounds, one articulator carries opposite value of the same feature
[t] Coronal [+anterior, -lateral]
[l, ľ] Coronal [+anterior, +lateral]

**[tr]** – not complex sound[2]
[t] Coronal [+anterior]
[r] Coronal [-anterior]

**[dn], [dň]** – not complex sounds, one articulator carries opposite value of the same feature
[d] Coronal [+anterior, -nasal]
[n, ň ] Coronal [+anterior, +nasal]

**[dl]** – not complex sound
[d] Coronal [+anterior, -lateral]
[l] Coronal [+anterior, +lateral**]**

**[dr]** – not complex sound[3]
[d] Coronal [+anterior, -fricative]
[r] Coronal [+anterior, +fricative]

Two initial CC clusters starting with nasal plosive form a complex sound. They involve different articulator, gestural overlap is possible: [m] is Labial, sounds [n, ň] have feature specification Coronal.

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But the clusters 'ml', 'mr' and 'ml' are not good complex sounds because of the conflicting gestures [+nasal] [-nasal].

26 out of 60 initial CC clusters starting with fricative cannot form a complex sound. These are the clusters: st, sť, sm, sn, sň, sl, sľ, zn, zň, zl, št, šť, šm, šn, šl, šľ, žm, žň, žľ, hn, hň, hm, xm, vn, vň, lž.

For example:
**[st], [sť]** – not possible complex sounds
[s] Coronal [+fricative]
[t, ť] Coronal [-fricative]

**[sn], [sň]** – not possible complex sounds
[s] Coronal [+fricative, -nasal]
[n], [ň] Coronal [-fricative, +nasal]

**[žľ]** – not possible complex sound
[ž] Coronal [-lateral], [ľ] Coronal [+lateral]

As to the initial CC clusters starting with affricate, 10 of them (namely cm, cn, cň, cl, cľ, čm, čn, čl, čľ, čr) cannot represent a complex sound. They involve the same articulator that makes opposite value of the same feature. For example, [č] Coronal [-nasal], [n] Coronal [+nasal], [čr] – not possible complex sound.

To sum up, 55 of all 142 initial CC clusters in Slovak cannot form a complex sound what represents almost 39% of all possible CC word-initial onset clusters. Duanmu argues that every consonant should be accounted for – although not every is syllabified (Duanmu, 2010, 5) – if it can serve as an affix (**Affix rule**, see above).

In Slovak, the affix rule accounts for the word initial [s], [z], [š], [v] and [d] that are called 'affix-like' sounds. For example, [s] in *snár* (*dream book*) is not a prefix, it is prefix-like sound accounted for by morphology.

If I exclude the monomorphemic initial CC clusters starting with [s, z, š, v, d], there are still 32 (22.5%) initial CC clusters that cannot be interpreted as complex sounds, neither the first sound in these clusters can be classified as an affix-like consonant.

The CVX theory of syllable offers another solution for unsyllabified consonants at word edges – **Potential V**: "*... a word initial C can serve as the coda of a potential V, which may come with a V-final prefix*" (Duanmu, 2010, 11). Slovak is a language with prefixes ending with a vowel, i.e. this rule is applicable. It seems that all Slovak initial CC clusters can fit the single-slot analysis.

As to the monomorphemic initial CCC clusters, there are 24 types of these clusters in Slovak and 20 of them can be solved by morphology: first consonant can be accounted for by morphology as potential affix (cf. Affix or affix-like rule). The remaining CC cluster is either a possible complex sound (e.g. 'kl' in 'skl') or it can be explained by Affix rule[4] and/or Potential V (e.g. 'tr' in ('str').

Four initial CCC clusters (hml, hmľ, mdl, ľst) cause difficulty for a single-slot analysis. Although there is the initial CC cluster 'hm' in Slovak, it is in a root morpheme, it is not a prefix. This cluster cannot be accounted for by the affix rule: neither 'hm', nor 'h' can be interpreted as an affix-like (or better prefix-like) sound(s). Both 'hm' and 'ml' (or 'mľ) are good complex sounds, but it is obvious that at least two-slot structure is required for the analysis of these clusters: either complex sound [hm] + [l/ľ], or [h] + complex sound [ml/ľ]. The situation with 'mdl' and 'ľst' is similar. The affix rule is not applicable. Complex sound analysis or/and Potential V rule result in two-slot structure.

Unsyllabified consonants in the initial CCCC cluster 'pstr' can be solved by morphology: [ps] is an affix-like segment

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and ‘t’ can serve as the coda of a potential vowel (Potential V rule). But the cluster ‘pštr’ remains a problem and requires three-slot structure: [pš] is a good complex sound, but [tr] not (see note IV) and should be treated separately.

## Conclusions

The idea of the unified (or universal) structure of syllable in all languages is not new in linguistics. For example, B. Hála, who defines syllable phonetically as the transition of speech organs from stricture to aperture while the pure laryngeal sound forms (Hála, 46), claims that the basic syllable model is CV (or better CVC) what reflects the physiology of our speech organs (closing – opening – closing). S. Dunmu came with the idea of the universal syllable structure CVX also on the higher, phonemic level. But whereas the single-slot analysis of some languages perfectly fits his assumptions, it seems that in the Slovak language the simplification of syllable onset may cause difficulties and at least two-slot onset template is required in this language. Similar observations were introduced by Marlo (2004) whose data from the Bella Coola language indicates the possible necessity to extend Duanmu’s model of syllable structure (ibid., 98).

But, of course, so as to gain more conclusive results, in the follow-up research, it will be necessary to concentrate on the CVX theory analysis of the word-final and word-medial consonant clusters in Slovak. Then more languages from each language family should be analysed in the same way in order to prove or disapprove a proposed universal nature of the maximal CVX structure of syllable.

**Notes**

[1] Only the most frequent consonant clusters occurring in domestic words were analysed. Types not tokens were taken into consideration.

[2] The cluster ‘tr’ can form a complex sounds in English (cf. Duanmu, 2009, 175), but not in Slovak due to the different feature specification of the sound [r] in the Slovak language.

[3] Analogically with the cluster ‘tr’, cluster ‘dr’ can form a complex sounds in English (cf. Duanmu, 2009,175), but not in Slovak due to the different feature specification of the sound [r] in the Slovak language.

[4] The question arises here if the affix rule is applicable only once in one consonant cluster or if it is applicable more times, if necessary, i.e. if the rule is cyclic or non-cyclic.

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